PB-217 458

BEAVER RESERVOIR STUDY. BENTON AND WASHINGTON COUNTIES, ARKANSAS

Public Health Service
Dallas, Texas

June 1959

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BEAVER RESERVOIR STUDY

Benton and Washington Counties
Arkansas

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Department of Health, Education, and Welfare
Public Health Service, Region VII
Dallas, Texas

In cooperation with the Department of the Army
U. S. Army Engineer District, Little Rock

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INTRODUCTION

General

By agreement with the District Engineer of the Little Rock District, U. S. Army Corps of Engineers, the Public Health Service initiated a study of the municipal and industrial water supply situation in relation to the proposed Beaver Reservoir. This agreement is in accord with the Memorandum of Agreement, dated November 4, 1958, between the Department of the Army and the Department of Health, Education, and Welfare pertaining to the Water Supply Act of 1958, Title III of Public Law 85-500.

The Beaver Reservoir project, White River Basin, Arkansas, was authorized under the Flood Control Act of 3 September 1954 (Public Law 780, 83rd Congress, 2nd Session) as recommended by the Chief of Engineers as House Document No. 499, 83rd Congress, 2nd Session. The recommendation provides for a multiple-purpose dam to be constructed for flood control, power generation, and other purposes. Under the terms of the Water Supply Act of 1958, provision may be made in the reservoir for water supply storage for municipal and industrial use.

Acknowledgments

The local people in the Beaver area, the State agencies, and several Federal agencies contributed considerably to the fulfillment of this study. The municipalities of Bentonville, Fayetteville, Rogers, and Springdale and their consulting engineer, Mr. L. M. McGoodwin, and the Beaver Dam Association furnished pertinent data.

The State agencies, including the Department of Health, the Stream Pollution Control Commission, the Graduate Institute of Technology of the University of Arkansas, and the Arkansas Industrial Development Commission provided information relating to their specializations.

The Little Rock District of the Corps of Engineers provided specific data on the project and on alternate sites for water supply storage as well as made appointments with interests in the project area.

Quality of water data and ground water data were obtained from the U. S. Geological Survey offices in Arkansas.

The cooperation and assistance of each of the above are gratefully acknowledged.

PROCEDURES

Contacts were made with the Little Rock District Office of the Corps of Engineers to obtain the engineering details of the Beaver project.

The State health and stream pollution control agencies reported on the water quality and waste disposal situation and indicated the probable consequences of reservoir development and economic change in the area.

The Arkansas Industrial Development Commission and the Graduate Institute of Technology of the University of Arkansas reported on their appraisal of the economic situation and the plans for the future of the area.

The Arkansas State Department of Conservation and Geology reported on legal arrangements related to Arkansas water rights and the interstate transmission possibilities.

In the immediate project area, where conferences were held with local officials and industrial and civic leaders, impressions were gathered on the potential for growth and its effect on water use. Mr. L. M. McGoodwin, consulting engineer, provided information and advice on local sources of water supply and cost data.

Water quality information was obtained from the Arkansas State Department of Health and the Water Quality Branch, U. S. Geological Survey. Supplementary water quality data were obtained by sampling in the area at six locations during the course of the investigation.

DESCRIPTION OF AREA

The site of the dam is to be on the White River (609 miles above the river mouth) in Carroll County, Arkansas, about six miles northwest of Eureka Springs and 30 miles northeast of Fayetteville. The reservoir will be in Carroll, Benton, and Washington Counties.

The basin upstream from the dam site comprises 1,186 square miles and lies in the Springfield Plateau area of the Ozark uplift region. The drainage area is rugged to mountainous and is covered with forests. The river above the dam site is about 118 miles long, winding, and confined in a narrow valley. The basin upstream is roughly rectangular in shape but broader near the headwaters. Principal tributaries are West Fork, Middle Fork, Richland Creek, and War Eagle Creek.

The Beaver Reservoir location is potentially valuable as a water supply to areas to the west and north. The reservoir would be located on the Ozark Plateau and would have a minimum pool elevation of 1,065 feet. Portions of the reservoir are approximately ten miles from the drainage basin to the west (Neosho-Grand River Basin).

The area has a relatively mild climate and well distributed rainfall. Its scenic beauty has been a definite attraction for both transient and retired persons.

ECONOMIC DEVELOPMENT

The U. S. Census for 1950 indicates a population of slightly more than 100,000 for the three-county immediate project area--Carroll, Benton, and Washington Counties. Two of the counties--Benton and Washington (population 82,300, 1958)--are undergoing industrialization as is manifested by new firms locating in the area, particularly food processing and light fabricating firms. Another indication of industrialization is the increase in urban population, contrasted with a rural decline. For example, the Bentonville-Rogers area of Benton County showed an increase of 600 persons from 1950-56, now totaling 8,500 people. The Fayetteville-Springdale area in Washington County grew by 2,500 persons from 1950-56, totaling 25,397.

The University of Arkansas at Fayetteville, with a current enrollment of over 5,000, constitutes an important part of the economic base of the area. Because of its potential for leadership, technical and professional talents, research, and instructional facilities, the University of Arkansas is a prime attractor for industrial site prospectors.

Though the area is not conspicuously endowed with important natural raw materials, hardwoods such as oak and hickory abound. Several minerals, however, are available relatively closely: lead and zinc in Missouri; oil and natural gas in Oklahoma and Texas; and coal and bauxite in Arkansas.

The area is served by the St. Louis-San Francisco and the Kansas City Southern Railroads with mainline facilities. U. S. Highway 71 traverses the two-county area from north to south with connecting links to main east-west highways at each end of the area.

An important recreational industry has developed in the area based on the waterways, woodlands, and mountains. These scenic assets and the excellent climate have also been attractive for a large retirement community.

The labor supply is adequate for present needs though there is no surplus.

Banking facilities, retail outlets, service establishments, news dissemination by radio and the press, and business communication facilities provide the other necessary components of a prosperous economy in the area.

Present industry in the area consists largely of light manufacturing and food processing. The latter is quite extensive and consists primarily of poultry and vegetable packing. Poultry packing is increasing very rapidly and Northwest Arkansas now ranks as a leading poultry-packing area in the United States.

PRESENT WATER USES

General

A description of the present water uses within Washington and Benton Counties in northwestern Arkansas will be given as the two counties are forming a Water District. The use of the term, "Water District," within the following report should be read to mean within the two counties.

The cities within the Water District have developed surface water sources only to their immediate foreseeable needs, undoubtedly due to financial limitations. Municipal and industrial water supplies have never exceeded the demand except for short periods of time. Consequently, when large water-using industries inquired as to locating in the area, the cities found that such industries could not be accommodated due to limitations of water supply. As a result, these industries have not been encouraged to locate in this area.

No significant ground water supply is available in the area. Attempts at well water development have proven expensive and futile. The U. S. Geological Survey data indicate that individual well water supplies would only provide 50 gpm or under. The potential for development of ground water in the area is very limited. Effort should be made to conserve rather than to further develop existing ground water supplies.

Watersheds of the White River, Illinois River, and Spavinaw Creek are the sources of most municipal supplies in the Water District.

Siloam Springs takes its water supply from an impoundment on the Illinois River. The present development provides a 4 mgd yield. With some improvements, the source could be developed to a 10 mgd yield.

Fayetteville takes its water supply from sources on the Illinois and the White Rivers. The present sources of supply, West Fork of the White River and Clear Creek of the Illinois River, cannot be expanded; therefore Fayetteville is presently developing additional White River sources. It is reported that 5 mgd will be developed upon completion of the present program and that the drainage area can further be developed to yield 60 mgd.

Rogers takes its present supply from Spring Lake and Lake Atalanta which furnish a maximum yield of 3 mgd.

Bentonville takes its supply from springs in the Grand River Basin which yield 2 mgd maximum.

Springdale takes its supply from Osage Creek in the Illinois River Basin. The yield from that source is reported to be 3 mgd, and the present source can be expanded to 7 mgd.

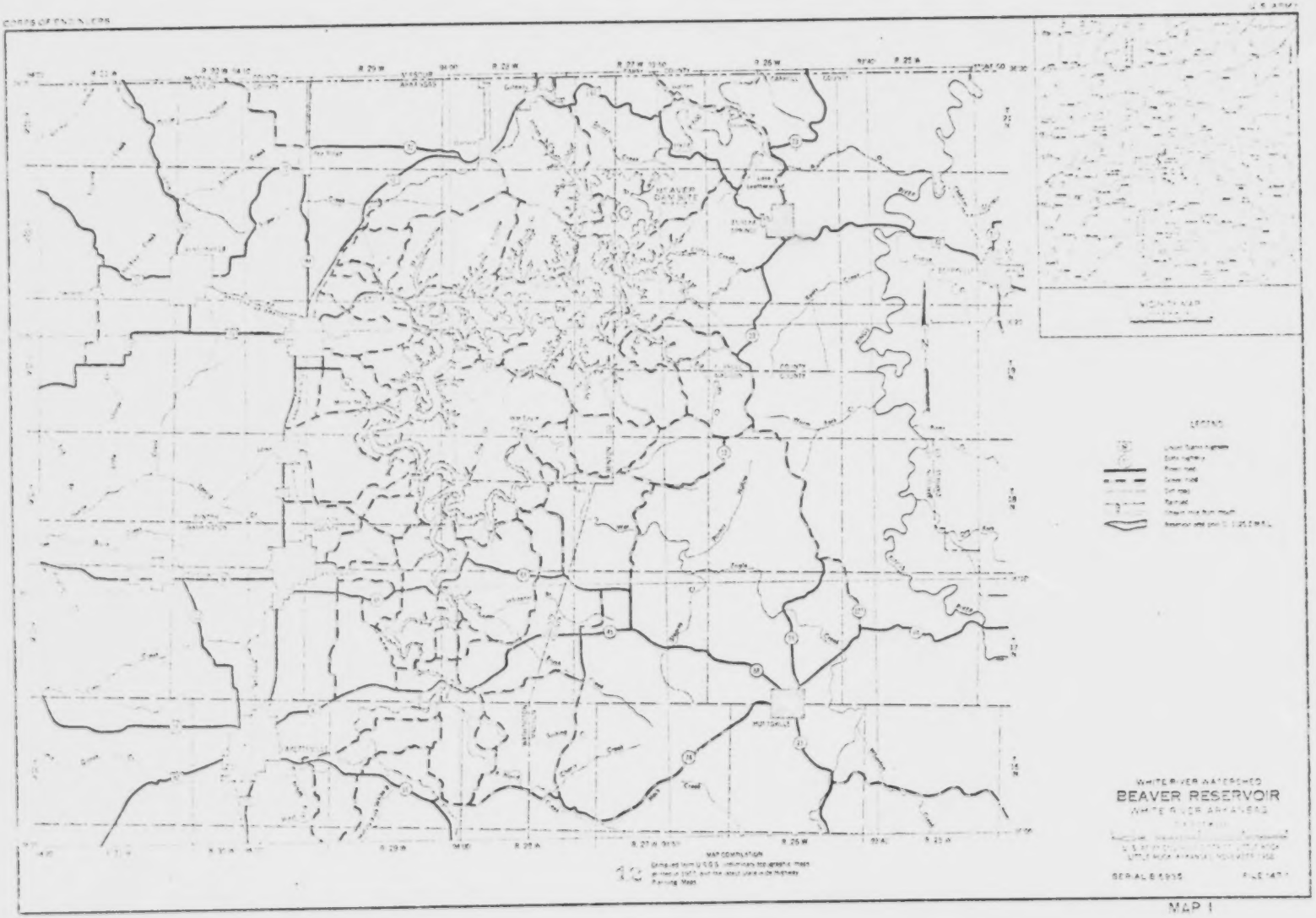
Domestic and industrial water use since 1940 for the five cities is shown in Table 1.

Table 1.

Industrial and Domestic Water Utilization for Benton and Washington Counties, 1940-58, by Urban Areas in Thousands of Gallons per Day

Date	Fayetteville	Rogers	Bentonville	Springdale	Siloam Springs	Other 1/	Total	Industrial	Total Domestic
1940	877	342	279	230	274	Not Avail.	2,002	1,235	767
1942	877	351	342	392	329	" "	2,291	1,495	796
1944	1,219	359	410	419	342	" "	2,749	1,907	842
1946	1,425	389	351	419	452	" "	3,036	1,803	1,233
1948	1,644	425	501	488	466	274	3,798	2,153	1,645
1950	1,534	499	625	967	479	329	4,433	2,991	1,442
1952	1,644	510	726	792	603	438	4,713	2,520	2,193
1954	2,137	567	790	874	630	548	5,546	2,957	2,589
1956	2,027	690	921	945	723	568	5,874	3,228	2,646
1958	2,260	904	759	1,195 2/	811	712	6,641	3,721	2,920
1959	-----	---	---	1,400	---	---	8,000 Est.	-----	-----

1/ Direct Acquisition and Minor Municipalities.
2/ At present time, Springdale has committed itself to apply an additional 1,400,000 gallons per day to an incoming industry.


CORPS OF ENGINEERS
U.S. ARMY
BEAVER DAM SITE
LEGEND
MAP COMPILATION
WHITE RIVER WATERSHED
BEAVER RESERVOIR
WHITE RIVER ARKANSAS
SERIAL B-5935
FILE 147-1

MAP I

At the present, industrial use of water exceeds the domestic and commercial use. All water comes from the municipal-owned sources. Food processing is a heavy water-using industry and is already well established in the area.

FUTURE WATER DEMAND ESTIMATES

The northwest Arkansas area has many favorable factors for future development. Some of the most prominent factors are the potential availability of an abundance of excellent quality water at the Beaver site, the presence of the University of Arkansas, and organizations at the State and local levels which are alert and skillful in the promotion of industrial prospects (the Arkansas Industrial Development Commission and its chairman, Winthrop Rockefeller, and the Beaver Dam Association, respectively). This unique combination of factors in conjunction with the traditional development assets--favorable location, excellence of transportation, skilled labor, raw materials, and desirable living conditions--give the area a decided competitive advantage over many other places aspiring to extensive growth.

As an example of why industries locate here, one industrial firm chose Fayetteville as the site for a large plant because of the distributional advantages and rail and road connections. This firm's economists predict that Joplin, Missouri--less than 100 miles to the

north--will become the population center of the United States within 50 years. The prediction is reasonable when the present population trend to the south and west sections of the United States is projected.

The now well recognized mobility of Americans means that no area which possesses the other necessities for industrialization, plus the combination of an attractive community and acceptable climate, need suffer because of inadequate labor supply. Thus, there is every reason to believe that Northwest Arkansas will attract the labor force once the employment opportunities appear.

A plentiful supply of water alone will provide the impetus for expansion. Coupled with other assets and alert salesmanship, the impact of ample water is expected to be dynamic.

Because of the plentitude of growth factors in the northwest Arkansas area, it is predicted that both the population and the industrial levels will increase dramatically when ample water supply for industrial, domestic, and commercial uses becomes available. The area will be on the verge of an expansion similar to that which Oklahoma City, Wichita, Tulsa, Little Rock, and Fort Worth experienced from 1900 onwards. If this occurs, a population growth to the range of 200,000 to 325,000 by 2015 is reasonable (see Figure 1 and Table 2).

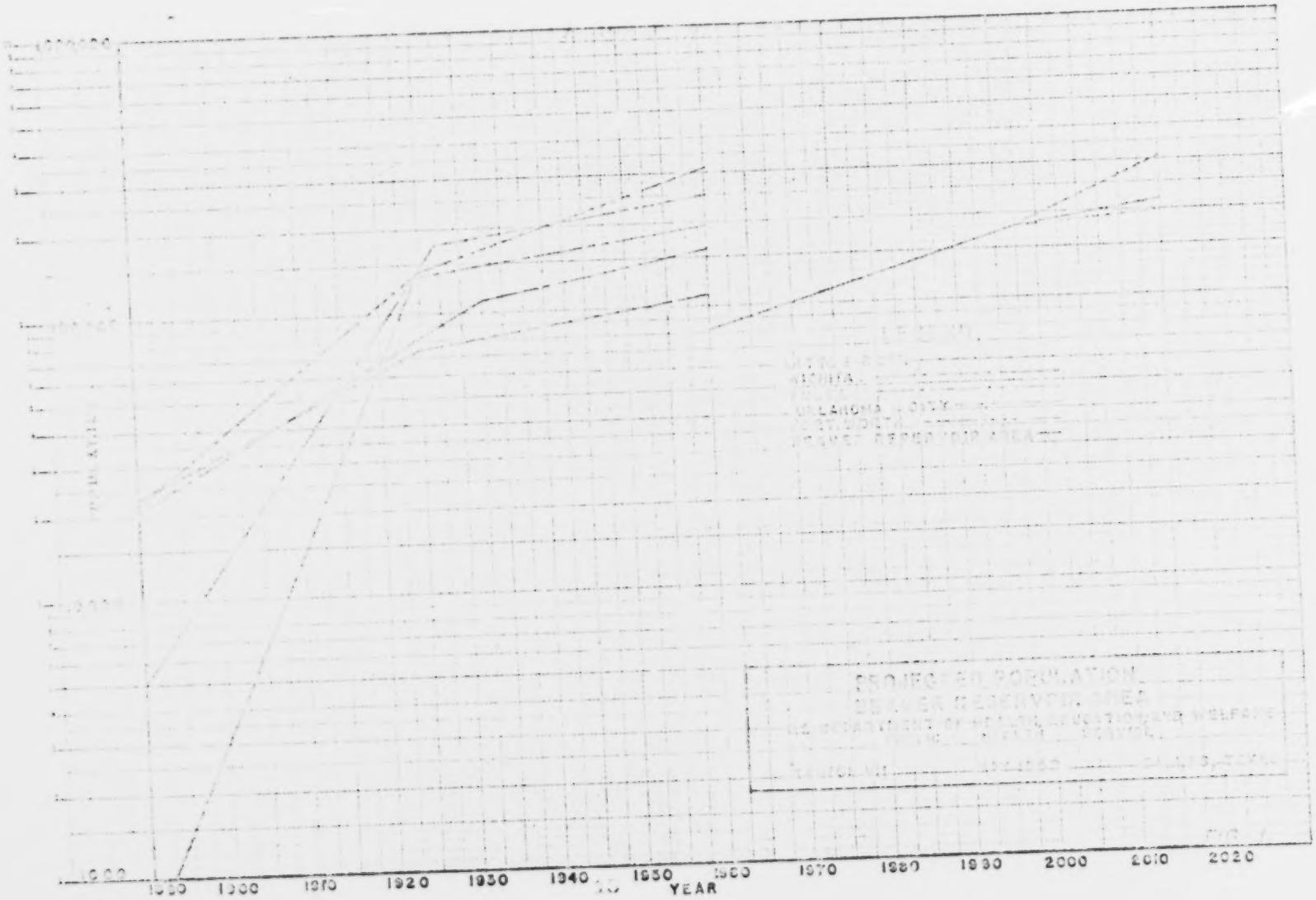

1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
YEAR

Table 2.

U. S. Census Population, Selected Cities, 1890-1950

Year	Little Rock	Wichita	Tulsa	Okla. City	Dallas	Ft. Worth
1890	25,874	23,853	-----	4,151	38,067	23,076
1900	38,307	24,671	1,390	10,037	42,638	26,688
1910	45,941	52,450	18,182	64,205	92,104	73,312
1920	65,142	72,217	72,075	91,295	158,976	106,482
1930	81,679	111,110	141,258	185,389	260,475	163,447
1940	88,039	114,966	142,157	204,424	294,734	177,662
1950	101,387	166,306	180,586	247,408	432,927	277,047

U. S. Census Population, Selected Standard Metropolitan Areas, 1940-50

Year	Little Rock	Wichita	Tulsa	Okla. City	Dallas
1940	156,085	143,311	193,363	244,159	398,564
1950	192,879	220,213	248,658	322,520	610,852

Population, Selected Urban Places in Washington and Benton Counties, Arkansas, 1930-58

Year	Springdale	Fayetteville	Bentonville	Rogers
1930	2,800	7,400	.....	.....
1940	3,319	8,212	2,359	3,550
1950	5,835	17,071	2,942	4,962
1956	7,328	18,069	3,495	5,000

The graphical projection for the Washington County and Benton County area is a composite of the growth characteristics of the five cities. It is realized that projections of this nature are largely judgmental in character; however, with the assurance of an ample water supply, it is concluded that such a population growth will occur along with an accompanying industrial expansion.

Although there has been a state-wide decline in population since 1940, it has been in rural areas. Urban areas have continued to grow as is manifested by the fact that 60 of the 63 communities above 2,500 population increased in size from 1940 to 1950. The three communities that lost population lost a total of only 319 people! Little Rock gained 14,000 during the same period, and North Little Rock gained over 22,000, doubling its population.

The situation since 1950 fortifies the conclusion of an urban gain and rural loss. Since that date, 26 Arkansas communities had special censuses. Each of these communities gained in population, some of them conspicuously (see Table 3). Magnolia gained 51 percent; Camden, 46.1 percent; North Little Rock and West Memphis, 30 percent each; Springdale, 25.5 percent; Fort Smith, 25 percent; and Fayetteville, 5.8 percent. Fayetteville and Springdale of this group are within the immediate area of the Beaver project.

These data and comparisons indicate that Arkansas is undergoing a rapid urban-industrial growth. The Beaver Reservoir area, with an ample water supply available and a multitude of other assets, will lead the state in this growth pattern.

Table 3.

Arkansas Urban Places, Showing 1950 U. S. Census Population and Special Census Population and Year

Urban Place	1950 U. S. Census Population	Special Census Population	Year
Benton	6,277	10,148	1957
Bentonville	2,942	3,495	1956
Blytheville	16,234	17,804	1956
Booneville	-----	2,632	1956
Camden	11,372	16,622	1955
Crossett	4,619	5,172	1955
El Dorado	23,076	24,477	1954
Fayetteville	17,071	18,069	1957
Forest City	7,607	8,985	1958
Fort Smith	47,942	59,959	1957
Harrison	5,542	5,617	1955
Jacksonville	-----	5,591	1956
Jonesboro	16,310	17,014	1956
McGehee	3,854	4,348	1955
Magnolia	6,918	10,426	1958
Malvern	8,072	9,243	1955
Marked Tree	2,878	3,065	1957
Newport	6,254	6,819	1957
North Little Rock	44,097	57,405	1958
Pine Bluff	37,162	39,795	1956
Searcy	6,024	7,371	1958
Springdale	5,835	7,328	1956
Stuttgart	7,276	8,062	1953
Texarkana	15,875	19,733	1956
Truman	3,744	4,133	1956
West Memphis	9,112	15,776	1955

The predicted population will require from 50 mgd to 81 mgd of water for domestic and light commercial needs, based on a per capita consumption of 250 gpd in the year 2015.

It is expected that within 20 years following the completion of the Beaver project 20 or more industries having a water demand from one to 12 mgd each will have located in northwestern Arkansas.

Industries likely to locate in this area will be those needing high quality water in large quantities, such as textiles, chemicals, food processing, and new industries; for example, those associated with the use of atomic energy or high energy fuel production. The industrial use of water is expected to exceed that used for domestic and light commercial uses.

Three approaches to the optimum water supply development potential were explored. The first approach was the determination of possible physical limitations of usage. The lowest limiting value was found to be the ability of the streams in the area to assimilate waste water from the urban and contemplated industrial complex. Computations based on present knowledge of treatment capabilities, hydrology and stream characteristics of the area indicate that about 160 mgd of highly treated wastes can be discharged into the streams without destroying their dignity. Industries must be carefully located within

the area in order to prevent overloading any one stream. The State Pollution Control Commission and the Water District will of necessity have to exercise control over location of industrial sites and urban community sewage outfalls.

The second approach involved the projection of historical use (see Figure 2). It will be noted that when compared with projections made by the electric and gas utilities, the annual rate of increase in water usage is somewhat less than either of the other utilities. All three utilities appear to be increasing an an exponential rate. Trend projections made by this method are justified where the population growth is less than 50 percent of saturation. It is believed that northwestern Arkansas is considerably less than 50 percent developed. Both the electric and gas utility groups are building facilities to meet the needs in the year 1975 as projected by this method.

The third approach involved the first two but is tempered with judgment and predicated on the earlier assumption that 20 or more industries having demands from one to 12 mgd will locate in northwestern Arkansas within a 20-year period following completion of the Beaver project. Figure 3 is an expression of judgmental factors concerning the timing and the volume of demand.

The water demand is expected to be more than 50 percent satisfied by 1990; therefore the rate of annual increase will begin to lessen, reaching a plateau of 200 mgd by the year 2015.

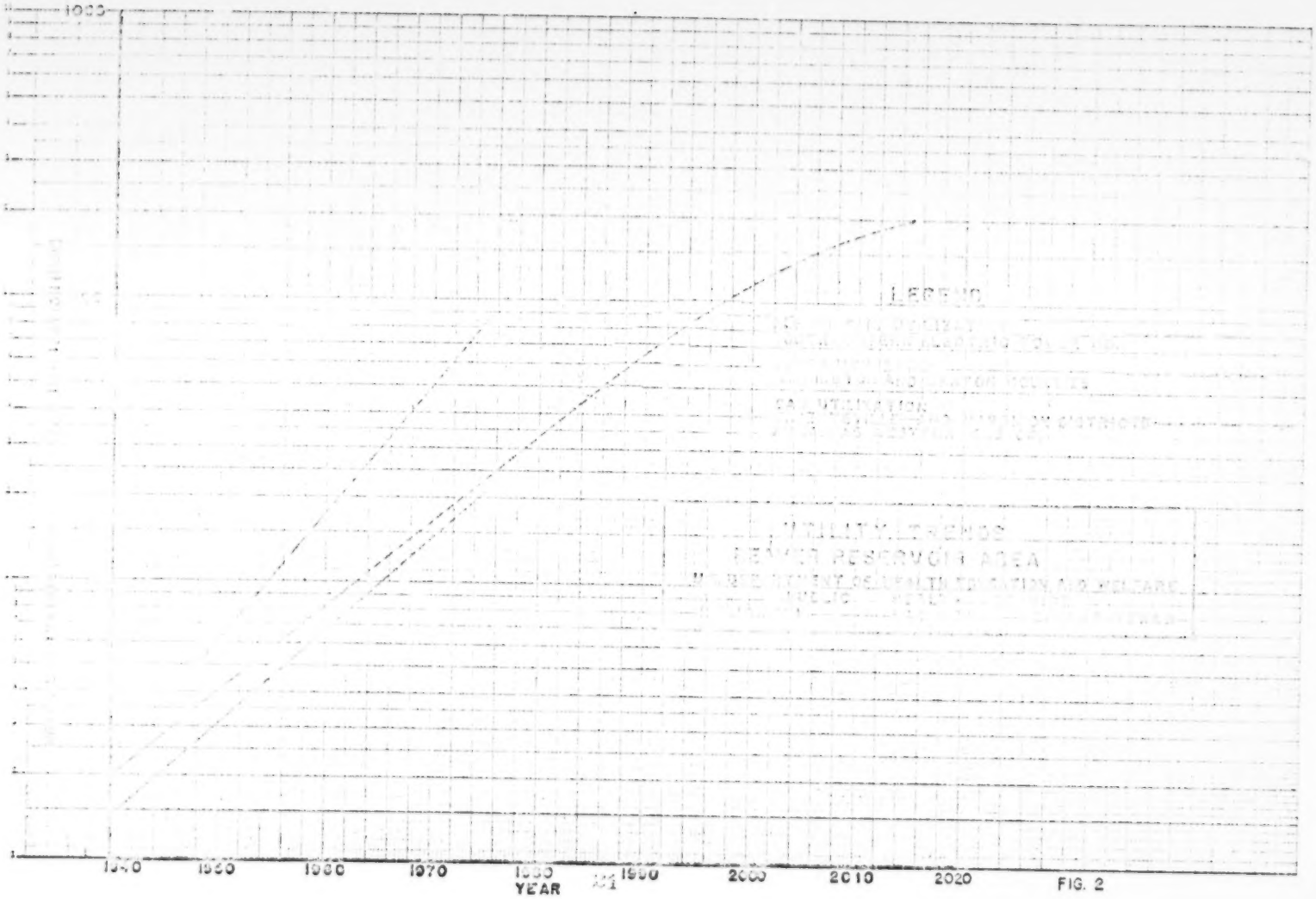


FIG. 2

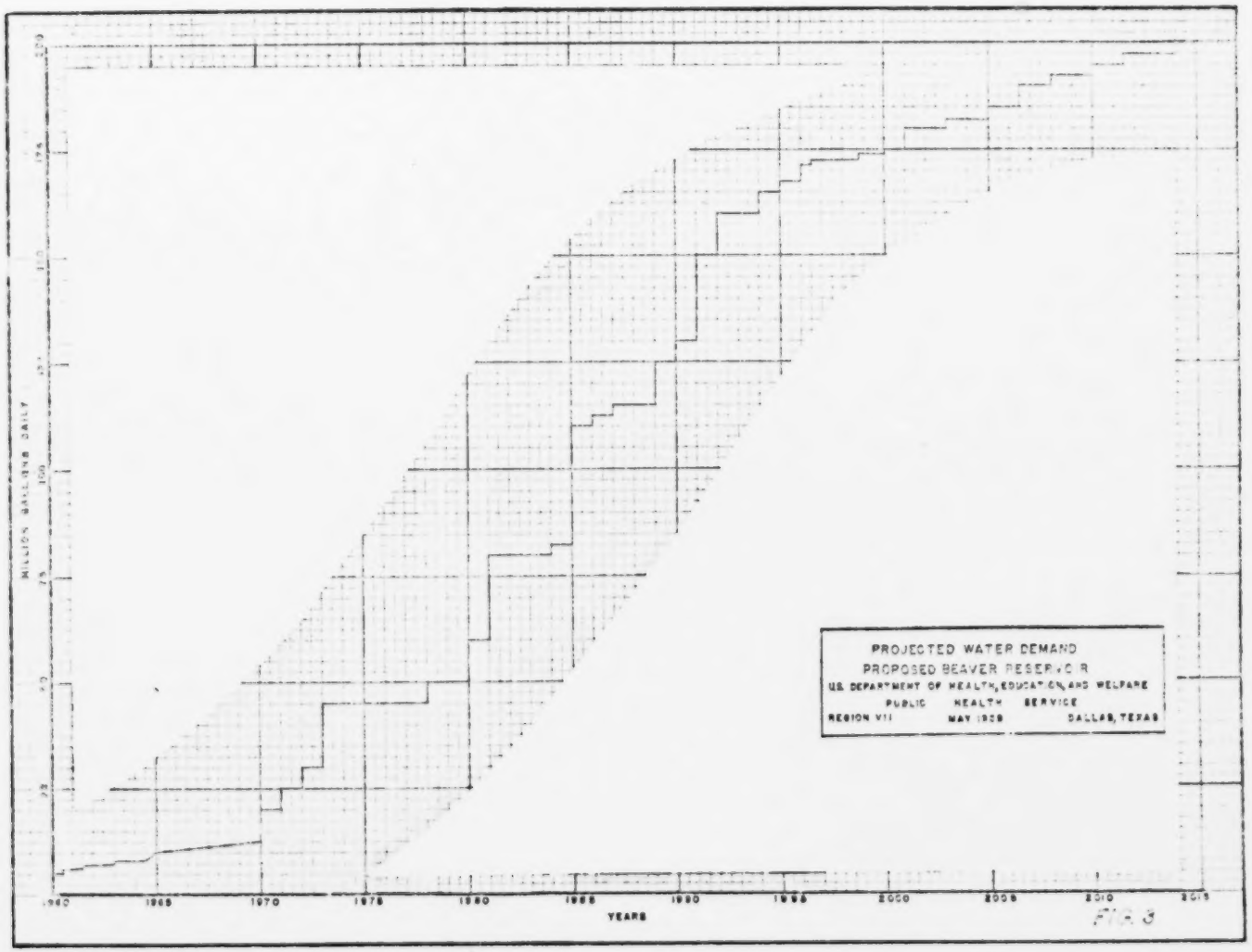

PROJECTED WATER DEMAND
PROPOSED BEAVER RESERVOIR
U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
PUBLIC HEALTH SERVICE
REGION VII
MAY 1958
DALLAS, TEXAS
MILLION GALLONS DAILY
YEARS
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015

FIG. 3

The projection coupled with the limiting factor imposed by the area's ability to handle its sewage and industrial wastes, indicates that 200 mgd usage in Northwest Arkansas is an optimum future water use for that area.

It is assumed that there will be no legal barriers which will limit or prohibit diversion of White River water to the Grand River Basin. It is further hypothesized that water taken from the proposed Beaver Reservoir will be returned in the amounts of 80 mgd to the White River watershed and 80 mgd to the Grand (Neosho) watershed. It is estimated that 40 mgd will be lost in consumptive use and/or to local ground water recharge.

The proposed Beaver project appears to be an ideal source of municipal and industrial water supply. The water is of excellent quality (see Appendix 1). The analyses indicate total dissolved solids of approximately 100 ppm and total hardness of approximately 80 ppm. By virtue of the project location in the headwaters of the White River, continued good quality and freedom from the effects of organic and inorganic pollution is virtually assured. There is very little pollution now in the contributary watershed.

The reservoir location is such that water may be transmitted readily to the north and west.

There will be virtually no siltation of the reservoir; thus it will remain useful for several hundred years. In this respect it should be considered a national treasure and therefore developed to the optimum point.

The immediate effect of developing the Beaver site will be felt in Benton, Washington, and Carroll Counties, Arkansas; however, secondary effects will be of national scope. The low cost of development, the high quality and abundance of water, and the nearness to the population center of the United States indicate that industries locating in this area would be able to produce goods at minimum cost in the market places of the United States. The adverse consequences of underdevelopment will be more serious than overdevelopment. Water supply for municipal and industrial use has never been overdeveloped in the United States.

The economic and population growth of the area is predicated on the construction of the Beaver Reservoir containing an optimum volume of water. Without ample water as the attractor, it is doubtful if industrial and urban development will require more than 60 mgd by the year 2015.

As the population and industry grow in Northwest Arkansas, there will be need for steam power electric development to satisfy power needs. Stored waters and return flows would assure a firm supply of cooling water of even temperature throughout the year. The volume of water needed for this purpose is estimated at approximately one cfs per 1,000 KW. This would be a benefit attributable to the development.

ECONOMIC EVALUATION

An evaluation of the Beaver Reservoir as a source of water supply for the area necessarily involves a comparison of Beaver Reservoir with the most economical equivalent alternate site capable of meeting future needs. The Corps of Engineers, Little Rock District, explored the several possible sites in the area. Sites considered were on Middle Fork of the White River, Osage Creek, and the Illinois River below Osage Creek. From information furnished, it was determined that the Illinois River site was the most economical equivalent alternative site. In addition to being the most economical, the Illinois River site is the only one which could furnish quantities of water up to 200 mgd.

The dam site of the alternate supply would be located on the Illinois River immediately below Osage Creek. The water supply reservoir would have a 20-foot depth conservation pool, and the water storage pool would be above the conservation pool elevation (1,065). There would

be a multiple-level water intake permitting water to be withdrawn from any of several levels. A raw water pipeline or lines would be constructed roughly along the route of Highway 68 to a point west of Springdale. The distance from raw water source to raw water reservoir near the treatment plant is 76,500 lineal feet. The discharge elevation is 1,320 feet while the average elevation from which water would be pumped ranges from 1,025 feet for 50 mgd to 1,055 feet for 200 mgd. Treatment of the Illinois River water would be identical to that of the Beaver Reservoir water. Near the treatment plant, a large raw water reservoir would be built in order to minimize pipeline sizes and pumping costs. From the Springdale treatment plant site, finished water would be pumped north to Lowell, Rogers, and Bentonville and south to Fayetteville.

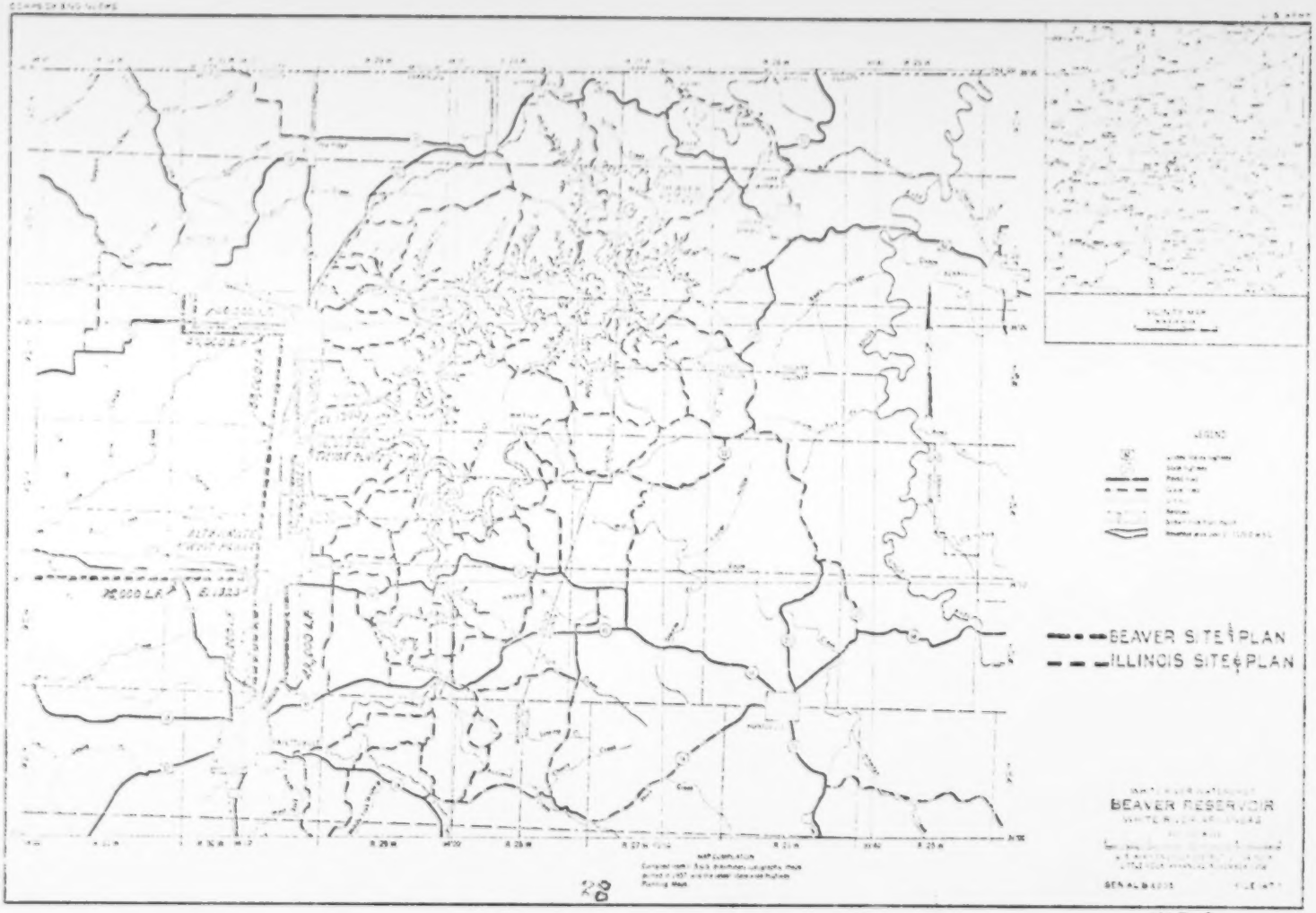
The water intake in Beaver Reservoir would probably be located approximately east of Lowell. A raw water pipeline or lines would be constructed to convey the raw water to a treatment plant site near Lowell. The length of this raw water line would be 18,500 lineal feet. A raw water reservoir would be built near Lowell to minimize pipeline sizes and pumping costs. The discharge of the raw water would be at an elevation of 1,340 feet. The average elevation from which raw water would be pumped from Beaver Reservoir would range from an elevation of 1,082 feet for 50 mgd to an estimated elevation of 1,097 feet for 200 mgd. From the Lowell plant, water would be pumped north to Rogers and Bentonville, and south to Springdale and Fayetteville.

In order to determine the value of Beaver Reservoir water supply storage, it was necessary to compare the two water systems (see Map 2) which would serve the area equally well and estimate the cost of each. It was not considered necessary to determine costs of items common or approximately equal to both systems. Common items are:

1. Water treatment cost
2. Equalizing raw water reservoirs near treatment plants
3. Treated water storage and distribution other than main transmission line costs
4. Inlet structures and pumps
5. Operation and maintenance of the systems

Factors which were considered to determine difference in cost of the two systems and value of Beaver Reservoir water storage are listed below:

1. Storage costs of Illinois Reservoir
2. Transmission and distribution costs where same are not common to both systems
3. Annual pumping cost differential of raw water to treatment plant due to differences in total dynamic head



MAP 2

The annual value of the water stored in the proposed Beaver Reservoir is estimated to be as follows:

50 mgd firm yield storage =	$ 564,070
100 mgd firm yield storage =	842,120
150 mgd firm yield storage =	1,297,820
200 mgd firm yield storage =	1,724,170

(See Appendix 2 for computations)

The computations of cost of the development of the Illinois site and accessory items were based on 4 percent interest and 50-year amortization period. This was done in preference to a 35-year, 4 percent, amortization base because it is believed that the Water District would not build the Illinois project to the full capacity by the year 1965. In fact, it would probably be built in three or four steps. If one takes into consideration inflationary factors, even in a minor degree, the ultimate cost to the Water District would be considerably higher than the cost basis used in this instance. It is believed that the values arrived at represent a fair middle position between the other two possibilities.

CONCLUSIONS

1. The Beaver site and the fine quality water represent one of the finest development opportunities for municipal and industrial water in the Southwest.

2. Water stored in the Beaver project can be protected from future pollution. The location of the Beaver project in the headwaters of the White River will enable control agencies to prevent or minimize future pollution of the waters flowing into the reservoir, thus protecting the existing quality.

3. The low cost of development indicates that less than optimum development would increase the ultimate cost of water in all affected areas. The optimum development for the Beaver site is believed to be in the realm of 200 mgd.

4. The economic value of this volume of water stored in the Beaver project is estimated at $1,724,170 per annum, based on the cost of developing the cheapest alternative source of a similar water supply.

5. The adverse consequences of underdevelopment will be more serious in our national economy than overdevelopment.

APPENDIXES

[illegible] STUDY
Water Quality Data
Upper White River Basin
(Arkansas)

I. [illegible] WATER

Date	Location	Yield (gpm)	Depth (ft.)	Spec. Cond. E x 10^6	Dissolved solids (ppm)	Hardness (ppm) NC	Hardness (ppm) Total	pH	Color	Fe (ppm)	Al (ppm)	SiO_2 (ppm)	Total Alk. (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	K (ppm)	CO_3 (ppm)	HCO_3 (ppm)	SO_4 (ppm)	Cl (ppm)	Fl (ppm)	NO_3 (ppm)	B (ppm)	PO_4 (ppm)
1/29/46	Bentonville, Benton Co.	Springs		225	142	--	100.	7.0	-	0.15	0.6	11.	---	39.	0.7	4.8	4.5	0	134	2.2	3.3	0.1	9.	---	---
1/--/57	Bentonville, Benton Co.	Springs		---	174	16	136.	7.3	-	0.05	0.	----	110	49.6	0.40	---	---	---	---	4.	5.	0.	---	---	0
1/29/46	Decator, Benton Co.	---	1,250	121	76	--	52.	7.6	-	0.15	0.6	8.6	---	19.	1.2	2.9	1.6	0	57	4.6	3.	0.	5.0	---	---
7/29/56	Decator, Benton Co.	---	1,250	326	178	3	160.	7.9	15	0.05	---	4.2	---	36.	17.	4.6	1.6	0	191	11.	6.5	0.1	0.3	---	---
3/--/57	Decator, Benton Co.	---	---	---	174	13	160.	7.8	-	0.09	0.	----	147	40.5	14.3	---	---	---	---	0	4.9	0.	---	---	0
1/29/46	Gentry, Benton Co.	(Combination of two wells)		336	322	--	282.	7.6	-	0.15	0.6	9.6	---	80.	0.7	38.	3.	0	225	10.	31.	0.	35.	---	---
1/29/46	Gentry, Benton Co.	(Dug Well)		331	---	--	162.	7.7	-	---	---	----	---	---	---	---	---	---	188	22.	6.	---	12.	---	---
1/29/46	Gentry, Benton Co.	(Drilled well)	80	560	---	--	133.	7.6	-	---	---	----	---	---	---	---	---	---	205	1.	50.	---	0.2	---	---
3/--/57	Gentry, Benton Co.	Spring		---	99	19	76.	7.9	-	0.02	0.	----	55	27.8	1.11	---	---	---	---	0.	3.	0.	---	---	0
1/29/46	Gravette, Benton Co.	100	240	354	222	--	142.	7.2	-	0.15	0.6	10.	---	55.	1.2	15.	1.8	0	146	6.1	28.	0.1	8.	---	---
1/--/57	Gravette, Benton Co.	---	---	---	194	0	99.2	7.5	-	0.13	0.	----	119	25.	8.8	---	---	---	---	5.	26.	1.5	---	---	0
1/29/46	Rogers, Benton Co.	Spring		276	168	--	122.	7.7	-	0.1	0.4	9.3	---	47.	1.2	6.9	1.7	0	135	3.1	10.	0.1	14.	---	---
8/--/55	Rogers, Benton Co.	285	1,700	---	178	12	160.	7.5	-	0.06	---	----	138	43.1	12.7	---	---	---	---	14.	4.2	0.1	---	---	0
11/-/57	Rogers, Benton Co.	Spring		---	197	25	138.	7.2	-	0.06	---	----	113	52.8	1.46	---	---	---	---	0.	10.5	0.05	---	---	0
1/29/46	Sulpher Springs, Benton Co.	500	14	276	162	--	128.	7.7	-	0.15	0.3	8.6	---	45.	3.7	6.6	1.8	0	157	7.9	4.5	0.	1.3	---	---
3/--/57	Sulpher Springs, Benton Co.	Spring		---	170	21	122.	8.1	-	0.02	---	----	101	45.	2.33	---	---	---	---	6.	4.5	0.	---	---	0
7/27/56	Pea Ridge, Benton Co.	50	1,274	413	225	12	187.	7.6	5	0.02	---	4.2	---	42.	20.	14.	2.7	0	213	11.	26.	0.1	0.3	---	---
7/27/56	Pea Ridge, Benton Co.	---	---	280	137	5	144.	7.4	5	0.02	---	3.6	---	45.	7.8	3.9	0.4	0	170	7.8	1.5	0.1	0.2	---	---
10/-/55	Pea Ridge, Benton Co.	---	---	---	255	27	184.	7.4	-	0.06	---	----	157	41.7	16.1	---	---	---	---	14.	26.9	0.35	---	---	0
1/30/53	Eureka Springs, Carroll Co.	30 gpd - Spring		336	186	13	185.	8.2	6	0.01	0.	8.	---	64.	4.1	2.3	1.	0	210	7.4	3.8	0.1	2.2	---	---
7/--/57	Eureka Springs, Carroll Co.	---	---	---	211	28	170.	8.	-	0.3	0.	----	150	33.9	20.7	---	---	---	---	12.	5.5	0.	---	---	0
7/28/56	Inspiration Point, Carroll Co.	---	1,000	341	190	13	175.	7.7	5	0.01	---	5.	---	39.	19.	4.1	1.6	0	198	16.	3.8	0.1	0.5	---	---
1/30/46	Huntsville, Madison County	Springs		332	215	--	153.	8.5	-	0.1	0.4	11.	---	58.	2.1	9.	1.6	0	172	5.4	8.	0.1	21.	---	---
1/30/46	Prairie Grove, Washington Co.	---	---	381	234	--	176.	7.3	-	0.15	0.5	9.6	--	64.	3.5	7.5	2.9	0	170	6.1	12.	0.	30.	---	--
10/-/55	Prairie Grove, Washington Co.	Mack Spring		---	261	40	182.	7.7	-	0.	---	----	2	75.7	2.4	---	---	---	---	0.	9.1	0.40	---	---	0
10/-/55	Prairie Grove, Washington Co.	Ruby Spring		---	281	21	146.	7.9	-	0.	---	----	125	63.	0.7	---	---	---	---	0.	6.8	0.05	---	---	0
1/29/46	Springdale, Washington Co.	0.7 mgd, Spring		310	191	--	136.	7.9	-	0.1	1.2	5.1	---	52.	1.4	8.7	2.2	0	136	34.	7.2	0.	11.	---	---
7/29/56	Springdale, Washington Co.	---	1,425	332	184	0	157.	8.1	5	0.12	---	1.7	--	60.	14.	10.	0.4	0	204	7.	4.	0.2	0.4	---	---
8/--/57	Springdale, Washington Co.	0.7 mgd, Spring		---	196	26	154.	7.	-	0.05	---	----	[illegible]	51.4	1.31	---	---	---	---	2.	10.	0.1	---	---	0
3/30/50	Summit, Washington Co.	---	41	57	39	2	15.	5.4	-	0.	1.1	6.5	---	2.2	2.3	4.1	1.1	0	4	1.7	6.5	0.	14.	---	---
3/-3/50	Summit, Washington Co.	---	42	80	56	5	31.	6.7	-	0.	0.7	21.	---	4.8	4.6	4.2	1.	0	37	1.7	6.	0.	2.9	---	---

BEAVER RESERVOIR STUDY
Water Quality Data
Upper White River Basin
(Arkansas)

II. SURFACE WATER

Date	Location		Discharge (cfs)	Spec. Cond. K x 10^6	Dissolved solids (ppm)	Hardness (ppm) NC	Hardness (ppm) Total	pH	Color	Fe (ppm)	Al (ppm)	SiO_2 (ppm)	Total Alk. (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	K (ppm)	CO_3 (ppm)	HCO_3 (ppm)	SO_4 (ppm)	Cl (ppm)	Fl (ppm)	NO_3 (ppm)	B (ppm)	Mn (ppm)
Water	White River at	Max.[1/]	13,220	216	129	16	113	--	--	---	---	---	---	38.	4.5	11.		---	137	8.6	7.	---	2.2	---	---
Year	Beaver, Ark.	Min.	41	103	73	0	40	--	--	---	---	---	---	13.	1.3	0.1		---	52	2.1	2.5	---	0.2	---	---
1946		Avg.	1,695	167	106	3	79	--	--	---	---	---	---	26.	3.1	5.6		---	95	5.4	4.1	---	1.2	---	---
3/21/46	White River at Beaver		1,040	115	70	1	52	8.6	--	0.2	---	7.9	---	18.	1.7	3.7	1.6	---	62	5.4	3.2	0.1	0.8	---	---
Water	White River at	Max.	19,610	236	137	15	118	8.7	50	---	---	---	---	38.	5.9	4.6	---	---	128	14.	5.	---	5.7	---	---
Year	Beaver, Ark.	Min.	149	86	41	0	33	7.3	2	---	---	---	---	10.	1.6	1.9	---	---	40	4.	1.	---	0.2	---	---
1950		Avg.	2,709	162	100	7	79	--	--	---	---	---	---	26.	3.6	3.3	---	---	88	6.7	2.9	---	2.2	---	---
7/1/50	White River at Beaver		370	211	133	5	106	8.1	3	0.03	---	13.	---	35.	4.6	3.1	2.2	---	124	7.	4.	0.1	2.	---	---
Water	White River at	Max.	30,880	269	150	15	133	8.3	40	---	---	---	---	44.	5.	3.9	---	---	147	14.	5.	---	3.1	---	---
Year	Beaver, Ark.	Min.	139	86	47	0	36	7.3	2	---	---	---	---	12.	1.5	1.4	---	---	37	2.9	2.	---	0.8	---	---
1951		Avg.	1,636	181	109	8	92	--	10	---	---	---	---	31.	3.6	2.6	---	---	103	6.2	3.3	---	1.6	---	---
8/21/50	White River at Beaver		181	206	126	4	103	7.6	5	0.06	---	11.	---	36.	4.5	2.9	1.6	---	121	4.6	4.	0.	1.	---	---
Water	White River at	Max.	10,100	256	162	14	122	8.6	60	---	---	---	---	41.	6.6	4.6	---	---	141	8.2	5.8	---	4.3	---	---
Year	Beaver, Ark.	Min.	70	65	77	0	49	7.1	3	---	---	---	---	15.	2.1	0.8	---	---	49	3.5	1.	---	0.6	---	---
1952		Avg.	1,574	166	106	7	83	--	11	---	---	---	---	27.	3.6	2.7	---	---	95	5.6	3.3	---	1.6	---	---
10/1/51	White River at Beaver		257	225	138	9	122	8.	5	0.12	---	8.3	---	41.	4.8	2.8	1.6	---	138	5.7	4.2	0.	2.	---	---
Water	White River at	Max.	11,960	269	170	12	125	8.5	50	---	---	---	---	43.	9.5	4.7	---	---	147	10.	5.2	---	3.6	---	---
Year	Beaver, Ark.	Min.	21	60	75	0	42	7.5	3	---	---	---	---	16.	1.	1.5	---	---	46	2.6	1.5	---	0.2	---	---
1953		Avg.	1,125	180	116	4	86	--	12	---	---	---	---	29.	3.6	3.	---	---	100	5.7	3.7	---	1.5	---	---
10/21/52	White River at Beaver		48	237	130	6	124	8.5	5	0.	---	12.	---	38.	7.2	3.7	1.5	---	145	4.9	6.3	0.1	0.2	---	---
6/16/58	White River at Beaver		---	151	78	4	74	8.	--	---	---	---	---	26.	3.4	2.1	---	0.	86	4.	2.5	---	0.4	---	---
7/23/58	White River at Beaver		---	213	---	4	110	8.	--	---	---	---	---	---	---	---	---	0.	129	5.	3.	---	1.1	---	---
9/18/58	White River at Beaver		---	221	118	4	115	8.	--	---	---	---	---	38.	4.9	1.8	---	0.	136	2.	3.2	---	1.	---	---
10/14/52	White River at Rogers		43	230	---	0	112	7.9	--	---	---	---	---	---	---	---	---	0.	136	2.	5.	---	2.1	---	---
2/5/53	White River at Rogers		339	136	---	4	56	8.2	--	---	---	---	---	---	---	---	---	0.	66	3.	4.	---	1.8	---	---
9/3/53	White River at Rogers		36	323	---	11	110	8.2	--	---	---	---	---	---	---	---	---	0.	121	2.	38.	---	0.2	---	---
Water	War Eagle Creek	Max.[2/]	---	211	128	8	110	7.8	11	---	---	---	---	40.	2.6	3.3	1.6	0.	128	7.	4.	---	1.8	---	---
Year	at Hindsville	Min.	---	88	58	0	40	7.2	2	---	---	---	---	16.	1.3	1.8	0.6	0.	65	1.2	2.5	---	0.	---	---
1959		Avg.	---	145	90	4	71	---	6	---	---	---	---	25.	1.9	2.3	1.	0.	82	4.5	3.	---	1.2	---	---
10/24/58	War Eagle Cr. at Hindsville		---	202	144	6	108	7.7	7	---	---	---	---	38.	3.1	3.	1.3	0.	126	5.6	3.8	---	1.	---	---
11/11/58	War Eagle Cr. at Hindsville		---	205	144	6	112	7.3	1	---	---	---	---	41.	2.6	2.3	1.1	0.	130	5.6	3.	---	0.8	---	---
12/2/58	War Eagle Cr. at Hindsville		---	145	105	8	69	7.5	6	---	---	---	---	23.	2.8	1.8	0.9	0.	76	6.4	3.	---	1.9	---	Tr
1/--/58	War Eagle Cr. at Huntsville		---	---	45	8	35	7.1	--	0.2	---	---	27	11.6	1.5	---	---	---	---	3.	0.[1/]	0.05	---	---	---
1/30/66	West Fork White River at Fayetteville		---	115	77	--	51	---	--	0.25	0.2	5.6	---	18.	1.6	5.3	1.6	0.	52	16.	3.	0.	0.7	---	---
9/--/55	West Fork White River at Fayetteville (Mt. Sequoyah Plant)		---	---	157	33	98	7.5	--	0.09	0.6	---	65	39.2	0.	---	---	---	---	22.	9.1	0.25	---	---	0.05
8/22/58	West Fork White River at Fayetteville (Pump Sta.)		---	109	82	4	50	7.	5	0.4	---	6.3	46	16.	2.3	2.6	1.1	0.	56	7.8	2.5	0.1	0.	---	---
5/12/58	West Fork White River at Greenland		---	66	52	3	29	6.7	15	0.06	---	6.9	---	9.2	1.6	1.8	1.1	0.	32	4.	2.	0.2	0.6	---	---
7/1/58	West Fork White River at Greenland		---	97	---	1	40	8.4	--	---	---	---	---	---	---	---	---	0.	47	8.	2.2	---	3.9	---	---
8/22/58	Middle Fork White River at Hwy 16 (E. of Fayetteville)		---	102	75	4	46	7.1	3	0.29	---	5.6	42	14.	2.6	2.2	0.9	0.	51	6.	1.8	0.1	0.3	---	---
8/22/58	White River at Roberts Bridge (5 mi. E. of Fayetteville)		---	85	57	3	38	6.9	5	0.3	---	4.6	31	11.	2.6	1.9	0.8	0.	42	5.	2.	0.1	0.	---	---
8/22/58	White River near Elkins (1 mi. E. of Elkins)		---	63	35	2	26	7.	5	0.26	---	4.6	25	7.2	2.	1.7	0.9	0.	30	3.8	1.8	0.1	0.2	---	---
9/--/55	Lake Fayetteville		---	---	107	80	80	6.9	--	0.15	0.	---	69	30.4	1.[illegible]	---	---	---	---	6.	3.6	0.25	---	---	0.38
8/22/58	Lake Fayetteville		---	112	69	2	53	7.7	6	0.13	---	1.9	51	19.	1.3	2.6	1.6	0.	62	4.6	3.	0.1	0.	---	---
ILLINOIS RIVER BASIN																									
4/29/56	East Osage Creek at Springdale (U.S. Source)		---	---	176	9	126	7.9	--	0.25	0.	---	115	53.2	0.7	---	---	---	---	0.	9.7	0.	---	---	0.
4/29/56	West Osage Creek at Springdale (U.S. Source)		---	---	158	8	120	7.9	--	0.26	0.	---	112	51.	0.96	---	---	---	---	0.	10.2	0.	---	---	0.
11/15/66	Clear Creek at Fayetteville (U.S. Source)		---	193	131	--	89	7.5	--	0.26	0.	6.6	---	36.	1.1	4.1	2.1	0.	86	31.	5.8	0.	10.	---	---
9/--/55	Clear Creek at Fayetteville (U.S. Source)		---	---	123	15	106	7.7	--	0.12	0.	---	91	40.9	0.9	---	---	---	---	7.	4.2	0.2	---	---	0.11

1/ Max., Min., and Avg., based on semi-weekly samples.
2/ Max., Min., and Avg., based on monthly samples.

APPENDIX 2
VALUATION COMPUTATIONS

Basic Data

I. Use following pipe sizes for flows:

MGD	Size	Cost ($)/ft. 1/
10	24"	15
15	30"	22
20	36"	28
30	42"	35
40	54"	52
60	60"	60
80	72"	75
100	84"	100

II. Estimate of pumping costs per mg/100 ft. head:

A. Energy costs = $0.009 per KWH

B. HP req'd. (24 hr. operation) = $\frac{1{,}000{,}000 \text{ gal.} \times \frac{8.34}{\text{gal.}} \times 100'}{24 \times 60 \times 33{,}000}$

= 17.6 HP

C. Motor efficiency = 90%
Pump efficiency = 82%

D. KWH = $\frac{17.6 \times .746 \text{ KW/HP}}{.9 \times .82}$ = 17.8 KWH

17.8 KW x $\frac{24 \text{ hr.}}{\text{day}}$ = 426 KW/MGD/100' head

E. Cost

426 x $0.009 = $3.84 MGD/100' head

1/ Based upon costs supplied by the Little Rock District, Corps of Engineers on 3/11/59.

Distribution Costs

III. Beaver site

A. Distribution:

	Prop. I - 50 mgd	Prop. II - 100 mgd
Springdale	15 mgd	30 mgd
Rogers	15 mgd	30 mgd
Bentonville	10 mgd	20 mgd
Fayetteville	10 mgd	20 mgd

	Prop. III - 150 mgd	Prop. IV - 200 mgd
Springdale	45 mgd	60 mgd
Rogers	45 mgd	60 mgd
Bentonville	30 mgd	40 mgd
Fayetteville	30 mgd	40 mgd

B. Pipe costs:

Proposition I - 50 mgd

	Length	Size	Unit Cost	Total Cost
Main Line	18,500'	60"	$60	$1,110,000
Springdale	26,000'	42"	35	910,000
Fayetteville	42,000'	24"	15	630,000
Rogers	26,000'	42"	35	910,000
Bentonville	30,000'	24"	15	450,000
			Total -----	$4,010,000

Proposition II - 100 mgd

	Length	Size	Unit Cost	Total Cost
Main Line	18,500'	84"	$100	$1,850,000
Springdale	26,000'	60"	60	1,560,000
Fayetteville	42,000'	36"	28	1,176,000
Rogers	26,000'	60"	60	1,560,000
Bentonville	30,000'	36"	28	840,000
			Total -----	$6,986,000

III.B. (cont'd)

Proposition III - 150 mgd (use 100 + 50)

	Length	Size	Unit Cost	Total Cost
Main Line	18,500'	60"	$60	$1,110,000
" "	18,500'	84"	100	1,850,000
Springdale	26,000'	42"	35	910,000
" "	26,000'	60"	60	1,560,000
Fayetteville	42,000'	24"	15	630,000
" "	42,000'	36"	28	1,176,000
Rogers	26,000'	42"	35	910,000
"	26,000'	60"	60	1,560,000
Bentonville	30,000'	24"	15	450,000
" "	30,000'	36"	28	840,000
			Total ----	$10,996,000

Proposition IV - 200 mgd (use 100 + 100)

	Length	Size	Unit Cost	Total Cost
Main Line	18,500'	84"	$100	$1,850,000
" "	18,500'	84"	100	1,850,000
Springdale	26,000'	60"	60	1,560,000
" "	26,000'	60"	60	1,560,000
Fayetteville	42,000'	36"	28	1,176,000
" "	42,000'	36"	28	1,176,000
Rogers	26,000'	60"	60	1,560,000
"	26,000'	60"	60	1,560,000
Bentonville	30,000'	36"	28	840,000
" "	30,000'	36"	28	840,000
			Total ----	$13,972,000

IV. Illinois site

A. Distribution:

	Prop. I - 50 mgd	Prop. II - 100 mgd
Springdale	15 mgd	30 mgd
Rogers	15 mgd	30 mgd
Bentonville	10 mgd	20 mgd
Fayetteville	10 mgd	20 mgd

	Prop. III - 150 mgd	Prop. IV - 200 mgd
Springdale	45 mgd	60 mgd
Rogers	45 mgd	60 mgd
Bentonville	30 mgd	40 mgd
Fayetteville	30 mgd	40 mgd

B. Pipe costs:

Proposition I - 50 mgd

	Length	Size	Unit Cost	Total Cost
Main Line	76,500'	60"	$60	$4,590,000
Rogers	53,000'	42"	35	1,855,000
Bentonville	30,000'	24"	15	450,000
Fayetteville	42,000'	24"	15	630,000
			Total -----	$7,525,000

Proposition II - 100 mgd

	Length	Size	Unit Cost	Total Cos
Main Line	76,500'	84"	$100	$7,650,000
Rogers	53,000'	60"	60	3,180,000
Bentonville	30,000'	36"	28	840,000
Fayetteville	42,000'	36"	28	1,176,000
			Total ----	$12,846,000

IV.B. (cont'd)

Proposition III - 150 mgd (use 100 + 50)

	Length	Size	Unit Cost	Total Cost
Main Line	76,500'	60"	$60	$4,590,000
" "	76,500'	84"	100	7,650,000
Rogers	53,000'	42"	35	1,855,000
"	53,000'	60"	60	3,180,000
Bentonville	30,000'	24"	15	450,000
" "	30,000'	36"	28	840,000
Fayetteville	42,000'	24"	15	630,000
" "	42,000'	36"	28	1,176,000
			Total ----	$20,371,000

Proposition IV - 200 mgd (use 100 + 100)

	Length	Size	Unit Cost	Total Cost
Main Line	76,500'	84"	$100	$7,650,000
" "	76,500'	84"	100	7,650,000
Rogers	53,000'	60"	60	3,180,000
"	53,000'	60"	60	3,180,000
Bentonville	30,000'	36"	28	840,000
" "	30,000'	36"	28	840,000
Fayetteville	42,000'	36"	28	1,176,000
" "	42,000'	36"	28	1,176,000
			Total ----	$25,692,000

Annual Pumping Costs

V. Beaver site - deliver raw water to Lowell

(Total dynamic head)

Proposition I - 50 mgd

(1) Friction loss = 0.6'/1,000' x 18,500'
= 11.1 ft.

(2) Static head:

Discharge elev. 1,340'
Aver. pump elev. 1,082'
258 feet

(3) TDH = 11 + 258
= 269 feet

Proposition II - 100 mgd

(1) Friction loss = 0.4'/1,000' x 18,500
= 7.4 feet

(2) Static head:

Discharge elev. 1,340'
Aver. pump elev. 1,088'
252 feet

(3) TDH = 7 + 252
= 259 feet

Proposition III - 150 mgd

(1) Friction loss = $\frac{\text{F.L. (50 mgd)} + \text{F.L. (100 mgd)}}{2}$

$= \frac{11 + 7}{2} = \frac{18}{2} = 9$ feet

(2) Static head:

Discharge elev. 1,340'
Aver. pump elev. 1,094'
246 feet

(3) TDH = 9 + 246 = 255 feet

V. (cont'd)

Proposition IV - 200 mgd

(1) Friction loss = $\frac{\text{F.L. (100 mgd)} + \text{F.L. (100 mgd)}}{2}$

$= \frac{7 + 7}{2} = 7$ feet

(2) Static head:

Discharge elev. 1,340'
Aver. pump elev. 1,100'
240 feet

(3) TDH = 7 + 240 = 247 feet

VI. Illinois site - deliver raw water to Springdale

(Total dynamic head)

Proposition I - 50 mgd

(1) Friction loss = 0.6'/1,000' x 76,500
= 46 feet

(2) Static head:

Discharge elev. 1,320'
Aver. pump elev. 1,025'
295 feet

(3) TDH = 46 + 295 = 341 feet

Proposition II - 100 mgd

(1) Friction loss = 0.4'/1,000' x 76,500
= 31 feet

(2) Static head:

Discharge elev. 1,320'
Aver. pump elev. 1,035'
285 feet

(3) TDH = 31 + 285 = 316 feet

VI. (cont'd)

Proposition III - 150 mgd

(1) Friction loss = $\frac{\text{F.L. (50 mgd) + F.L. (100 mgd)}}{2}$

$= \frac{46 + 31}{2} = \frac{77}{2} = 38$ feet

(2) Static head:

Discharge elev. 1,320'
Aver. pump elev. 1,046'
274 feet

(3) TDH = 38 + 274 = 312 feet

Proposition IV - 200 mgd

(1) Friction loss = $\frac{\text{F.L. (100 mgd) + F.L. (100 mgd)}}{2}$

$= \frac{31 + 31}{2} = 31$ feet

(2) Static head:

Discharge elev. 1,320'
Aver. pump elev. 1,055'
265 feet

(3) TDH = 31 + 265 = 296 feet

Annual Pumping Cost Differential

VII. Beaver vs. Illinois

(Energy cost = $3.84 per KW/MG/100' head, p. 1)

Proposition I - 50 mgd

TDH - Illinois site - 341'
TDH - Beaver site - 269'
Total differential= 72 feet

Diff. cost = 50 mgd x .72' x $3.84 = $138.00/day
@ 50 mgd = $50,300.00/year

VII. (cont'd)

Proposition II - 100 mgd

TDH - Illinois site - 316'
TDH - Beaver site - 259'
Total differential= 57 feet

Diff. cost = 100 mgd x .57' x $3.84 = $219.00/day
@ 100 mgd = $79,750.00/year

Proposition III - 150 mgd

TDH - Illinois site - 312'
TDH - Beaver site - 255'
Total differential= 57 feet

Diff. cost = 150 mgd x .57' x $3.84 = $328.00/day
@ 150 mgd = $120,000.00/year

Proposition IV - 200 mgd

TDH - Illinois site - 296'
TDH - Beaver site - 247'
Total differential= 49 feet

Diff. cost = 200 mgd x .49' x $3.84 = $375.00/day
@ 200 mgd = $136,500.00/year

Total Costs

VIII. Illinois site

A. Storage cost - 50 yr. Amortization - 4%

(1) 50 mgd - cost = $7,510,000
Annual cost = $7,510,000 x 0.0466
= $349,970

(2) 100 mgd - cost = $10,500,000
Annual cost = $10,500,000 x 0.0466
= $489,300

(3) 150 mgd - cost = $15,900,000
Annual cost = $15,900,000 x 0.0466
= $740,940

(4) 200 mgd - cost = $22,350,000
Annual cost = $22,350,000 x 0.0466
= $1,041,510

VIII. Illinois site (cont'd)

B. Transmission line cost - 50 yr. Amortization - 4%

(1) 50 mgd - cost = $7,525,000
Annual cost = $7,525,000 x 0.0466
= $350,670

(2) 100 mgd - cost = $12,846,000
Annual cost = $12,846,000 x 0.0466
= $598,620

(3) 150 mgd - cost = $20,371,000
Annual cost = $20,371,000 x 0.0466
= $949,290

(4) 200 mgd - cost = $25,692,000
Annual cost = $25,692,000 x 0.0466
= $1,197,250

C. Pumping differential cost

(1) 50 mgd
Annual cost = $50,300

(2) 100 mgd
Annual cost = $79,750

(3) 150 mgd
Annual cost = $120,000

(4) 200 mgd
Annual cost = $136,500

D. Total annual cost

	50 mgd	100 mgd	150 mgd	200 mgd
Storage - - - - - -	$349,970	$489,300	$740,940	$1,041,510
Transmission - - - -	350,670	598,620	949,290	1,197,250
Pumping differential	50,300	79,750	120,000	136,500
	$750,940	$1,167,670	$1,810,230	$2,375,260

IX. Beaver site

A. Transmission line cost - 50 yr. Amortization - 4%

(1) 50 mgd - cost = $4,010,000 (p. 2)
Annual cost = $4,010,000 x 0.0466
= $186,866

(2) 100 mgd - cost = $6,986,000 (p. 2)
Annual cost = $6,986,000 x 0.0466
= $325,547.60

(3) 150 mgd - cost = $10,996,000
Annual cost = $10,996,000 x 0.0466
= $512,413.60

(4) 200 mgd - cost = $13,972,000
Annual cost = $13,972,000 x 0.0466
= $651,095.20

B. Pumping differential= 0

C. Total annual cost w/o storage

	50 mgd	100 mgd	150 mgd	200 mgd
Transmission -	$186,866.00	$325,547.60	$512,413.60	$651,095.20
Differential -	-0-	-0-	-0-	-0-
Total -------	$186,866.00	$325,547.60	$512,413.60	$651,095.20

X. Value of Beaver Reservoir storage based on most economical equivalent alternate storage

	50 mgd	100 mgd
A. Total annual Illinois cost -------	$750,940.00	$1,167,670.00
B. Total annual Beaver cost w/o storage ----------	186,870.00	325,550.00
Value of Beaver storage (A-B) ---------	$564,070.00	$ 842,120.00
Value per mgd/yr. ----------	$ 11,281.40	$ 8,421.20

X. Value of Beaver Reservoir storage based on most economical equivalent alternate storage (cont'd)

	150 mgd	200 mgd
A. Total annual Illinois cost ----	$1,810,230.00	$2,375,260.00
B. Total annual Beaver cost w/o storage ----------	512,410.00	651,090.00
Value of Beaver storage (A-B) -------	$1,297,820.00	$1,724,170.00
Value per mgd/yr. ----------	$ 8,652.10	$ 8,620.85

RESUME OF BEAVER WATER SUPPLY VALUE STUDIES

Quantity (mgd)	Annual storage value ($)
50	$ 564,070
100	842,120
150	1,297,820
200	1,724,170